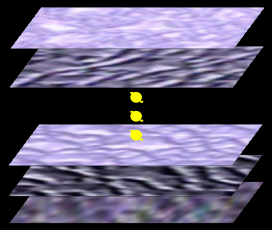
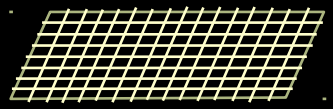
Texton Map Synthesis on Surface

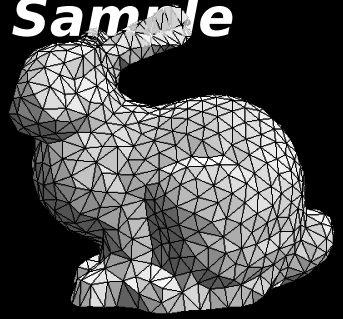


BTF Sample

Texton Analysis



Sample Texton Map



Mesh

Texton Map Synthesis on Surface

Surface Texton Map

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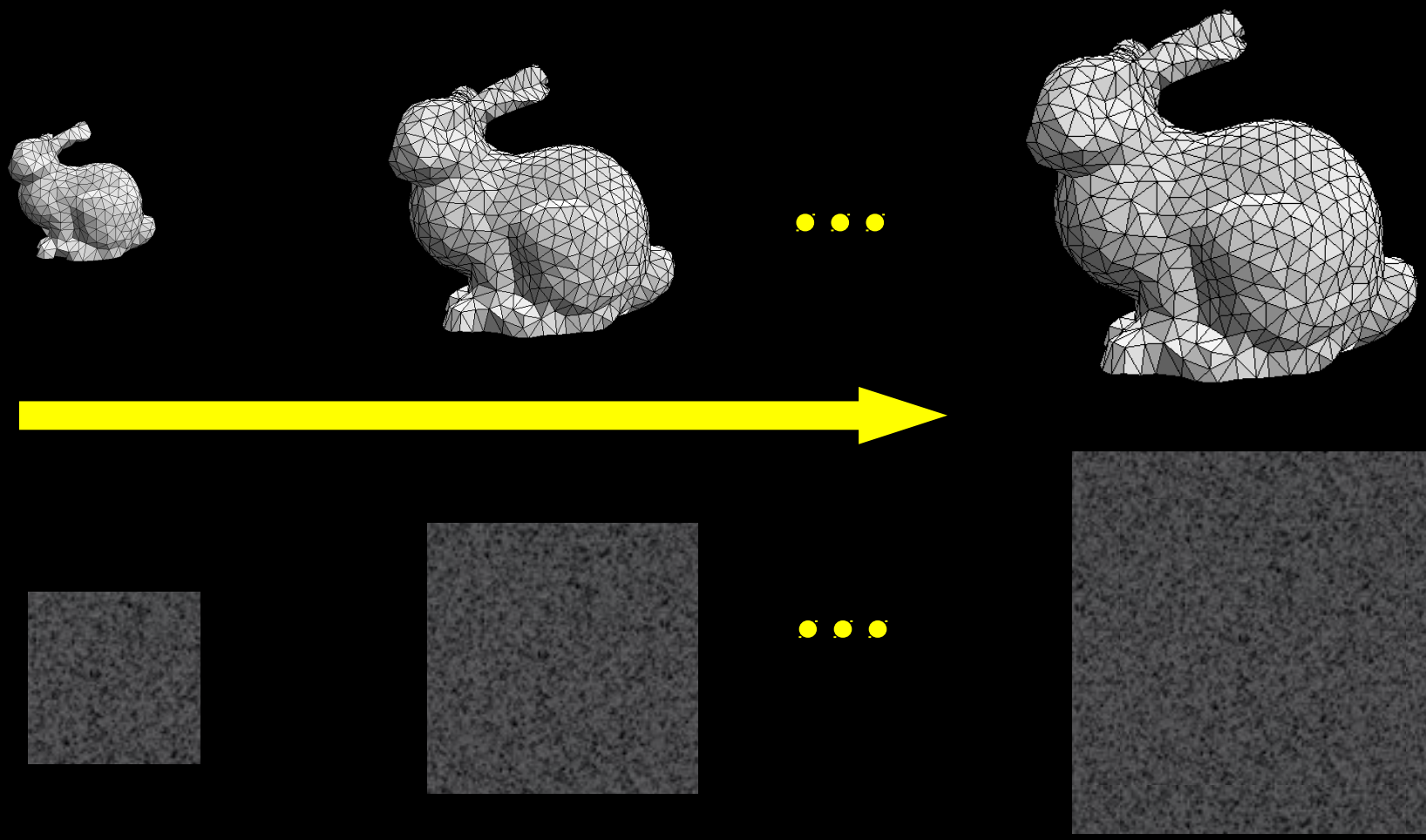
Multiresolution Synthesis



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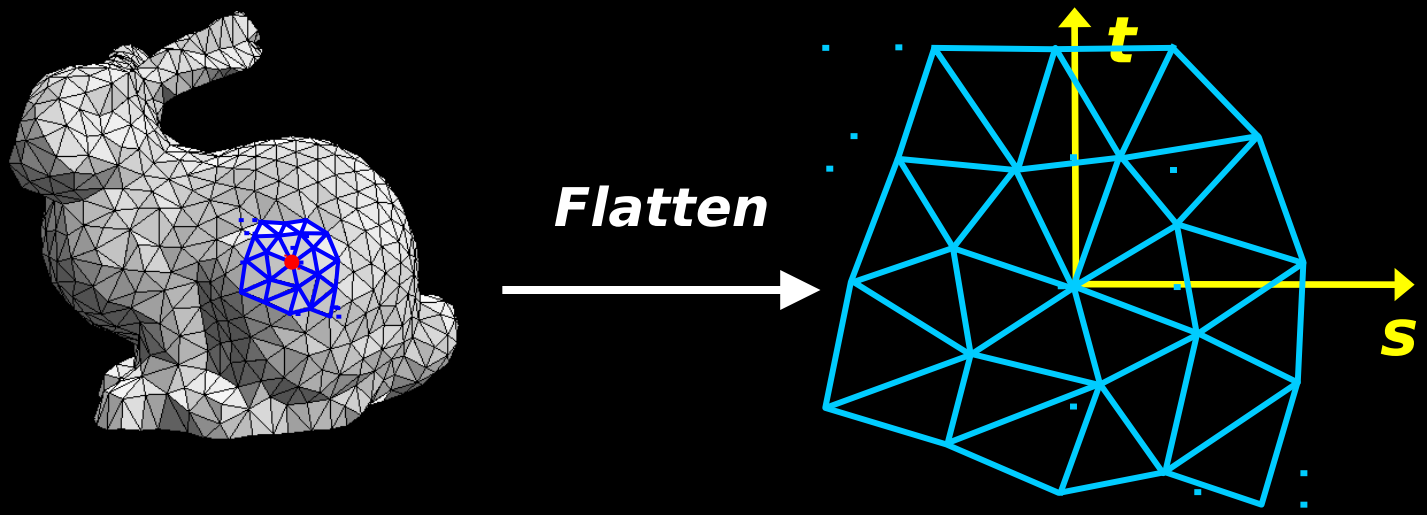
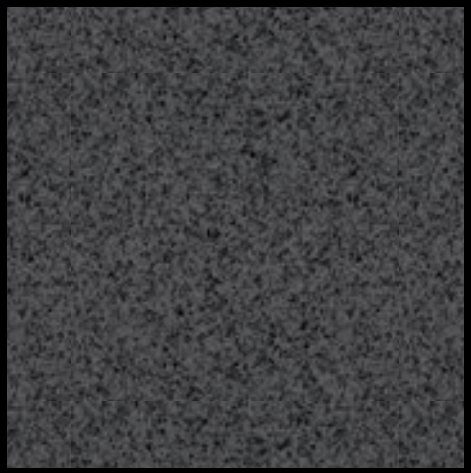
Flatten





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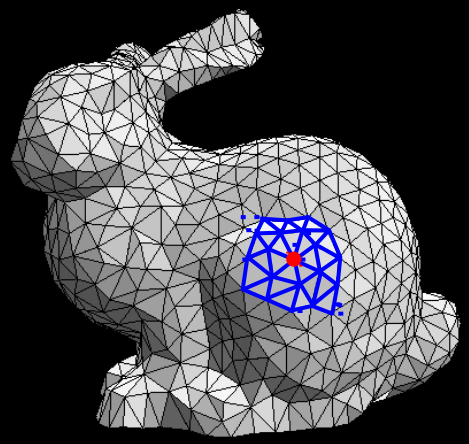
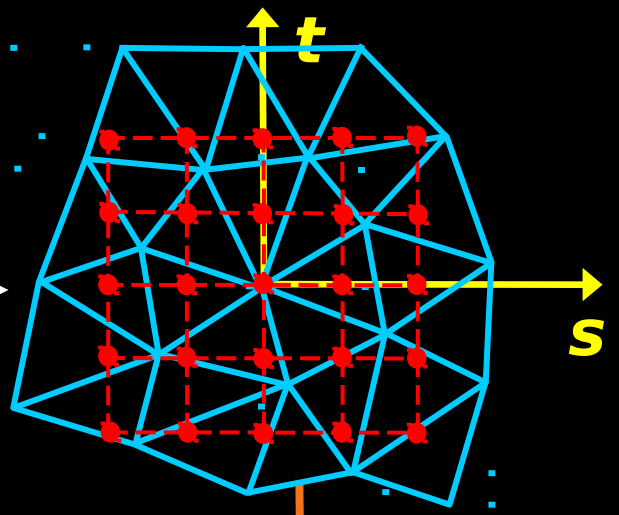
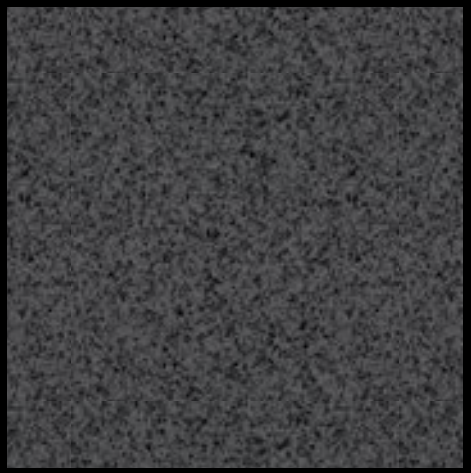
Resample

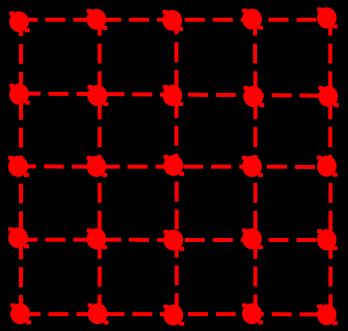


Flatten



Resampl
e





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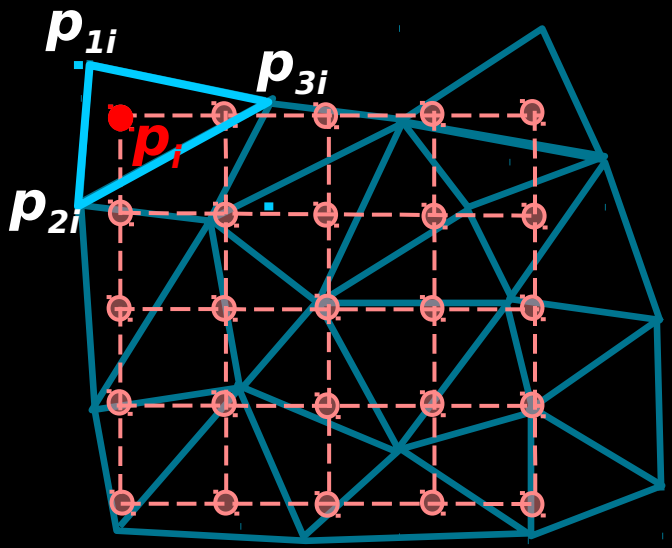
Resample



$$v(p_i) = \alpha v(p_{1i}) + \beta v(p_{2i}) + \gamma v(p_{3i})$$

We store (α, β, γ, Tp_{1i}, Tp_{2i}, Tp_{3i})

Texton labels

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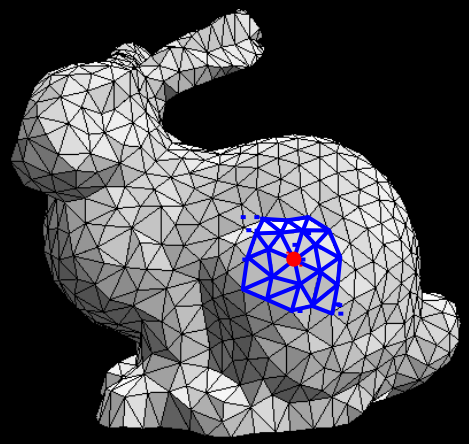
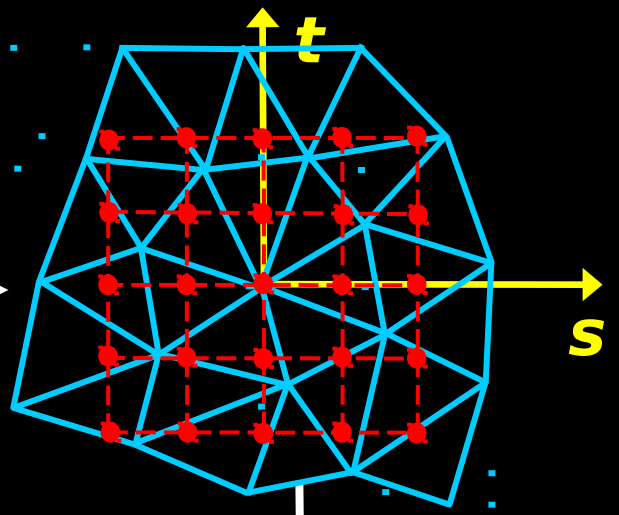
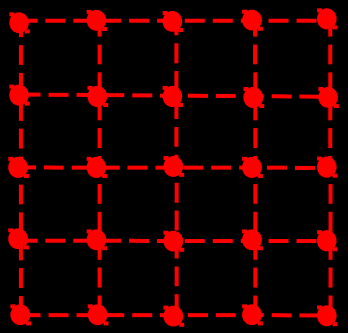
Search



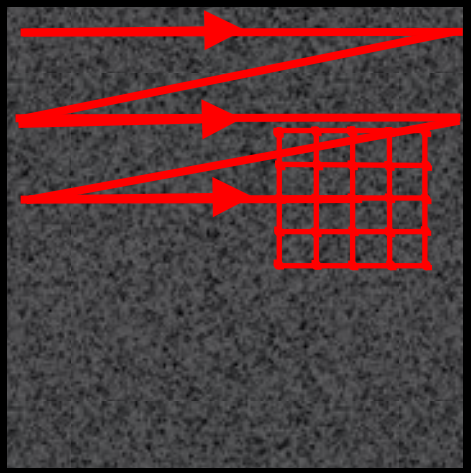
Flatten



Resample



Search



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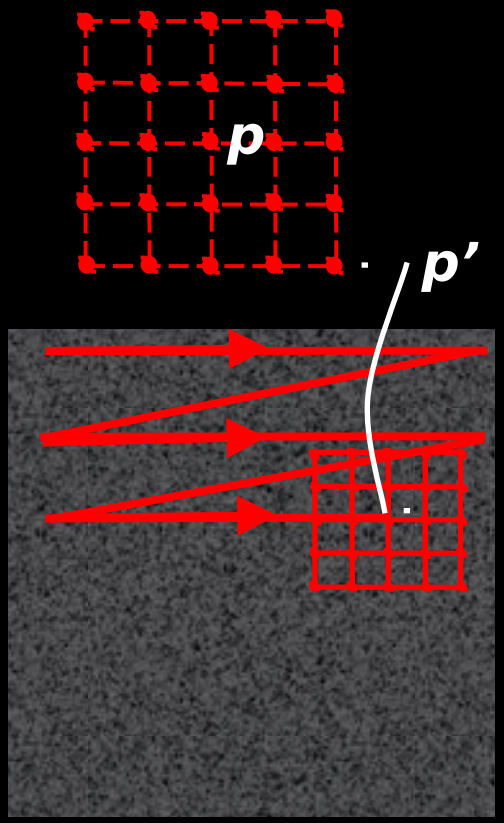
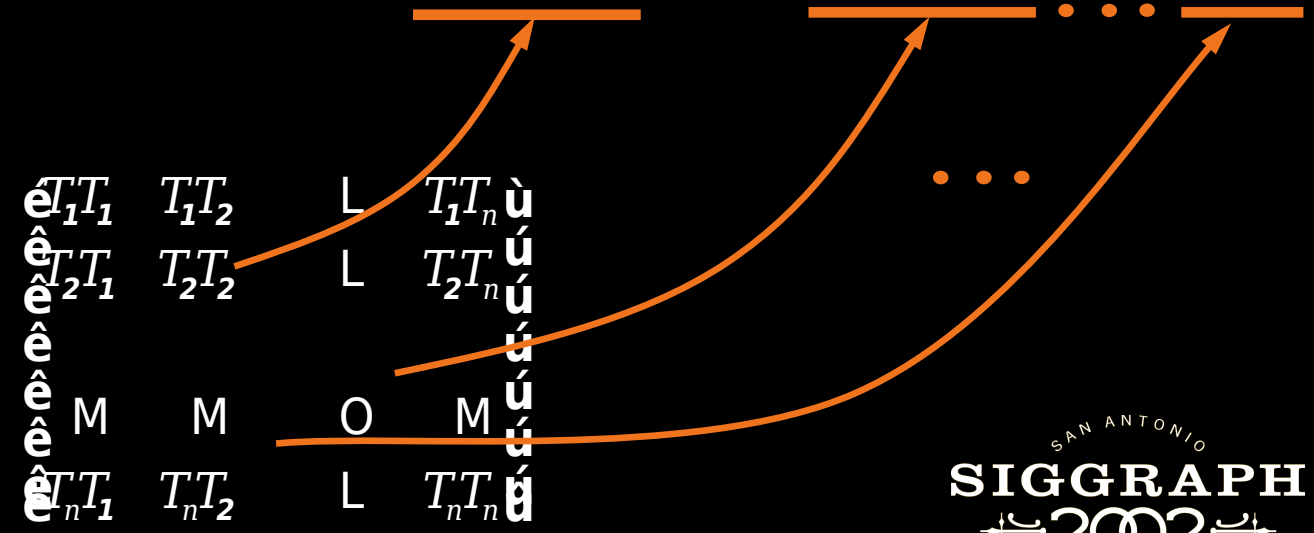
Search



$$d(p,p') = \sum_i (v(p_i) - v(p_i'))^2$$

$$= \sum_i (a\,v(p_{i1}) + b\,v(p_{i2}) + g\,v(p_{i3}) - v(p_i'))^2$$

$$\begin{bmatrix} T_1T_1 & T_1T_2 & \cdots & T_1T_n \\ T_2T_1 & T_2T_2 & \cdots & T_2T_n \\ \vdots & \vdots & \ddots & \vdots \\ T_nT_1 & T_nT_2 & \cdots & T_nT_n \end{bmatrix}$$



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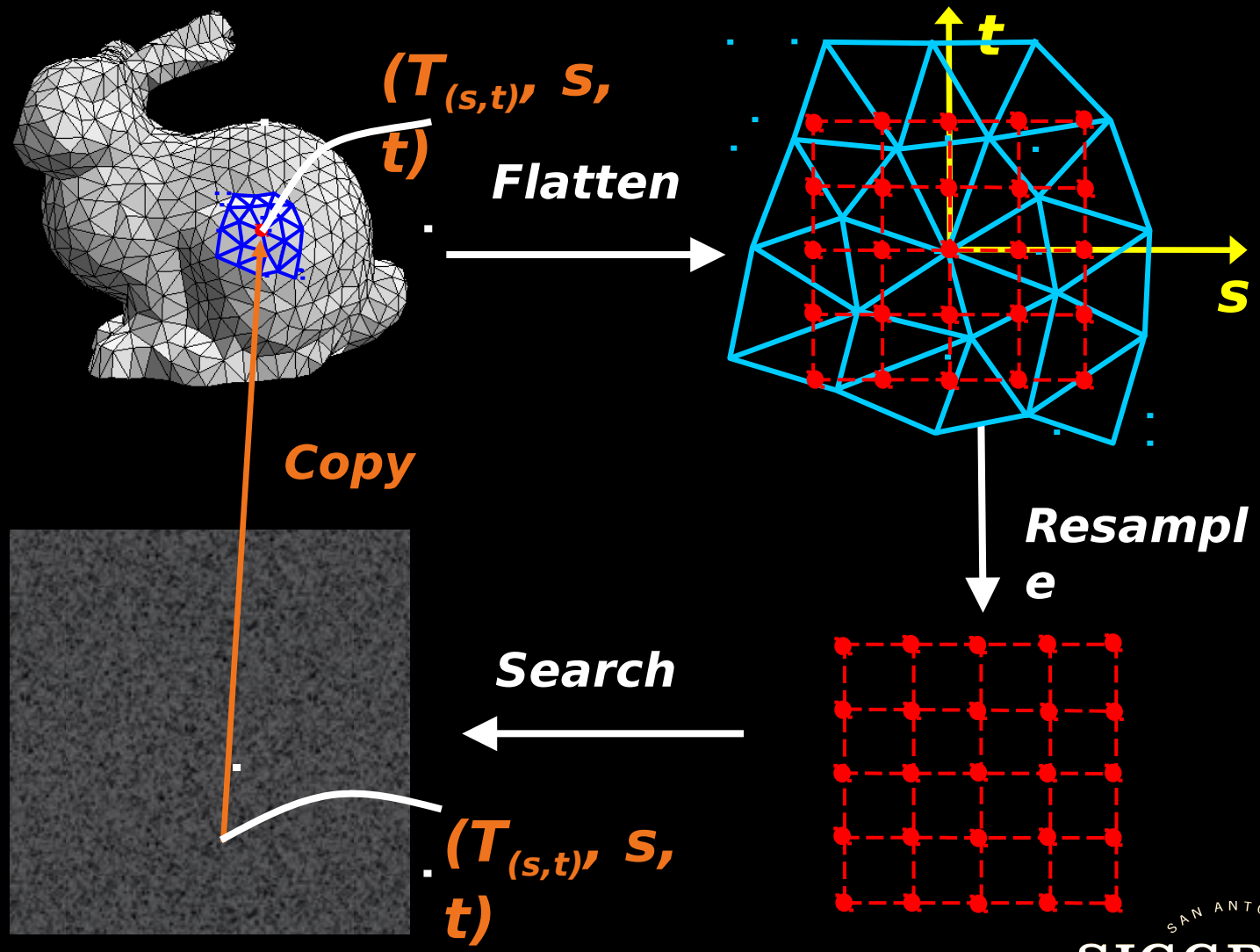
Copy



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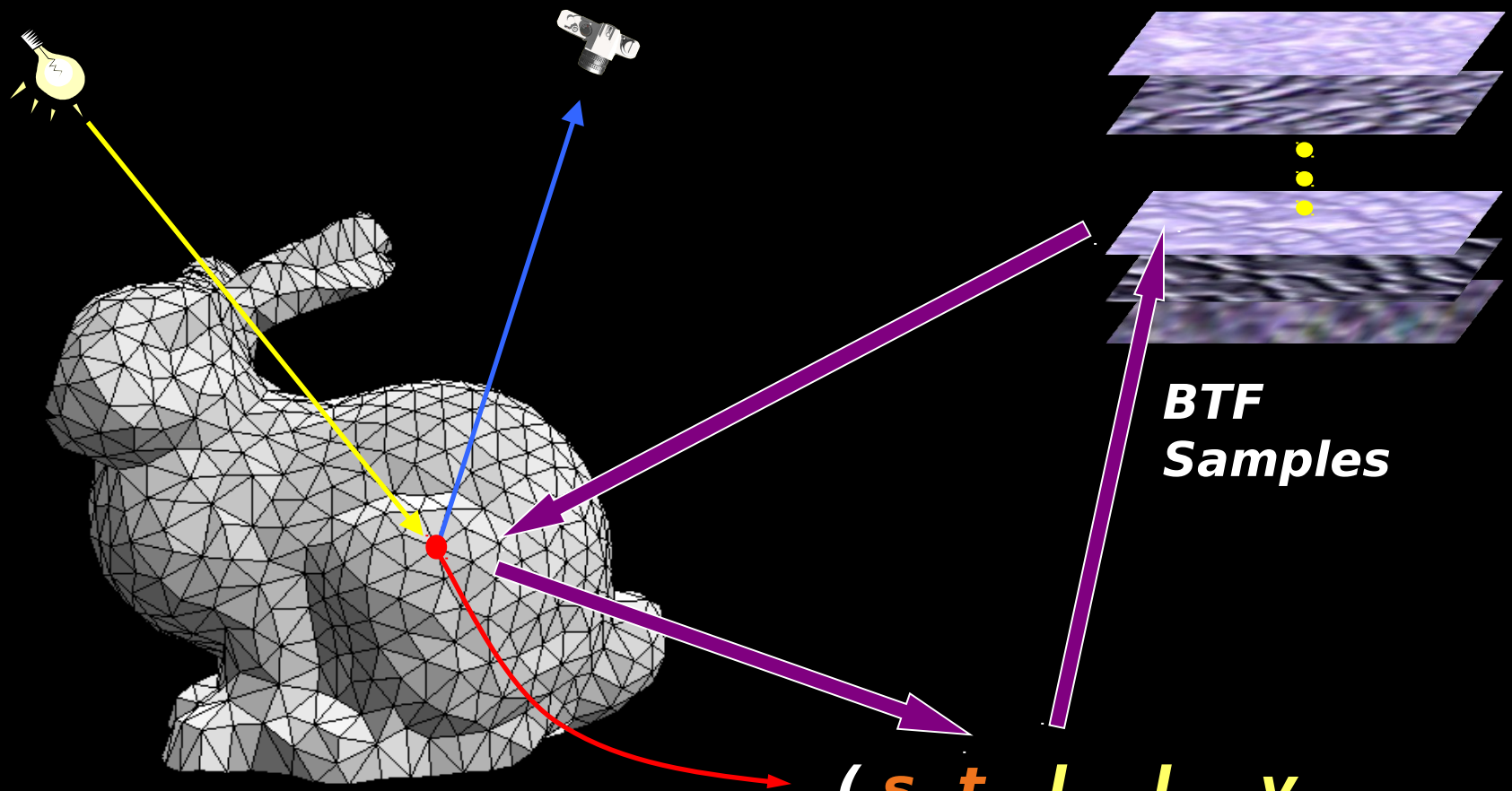
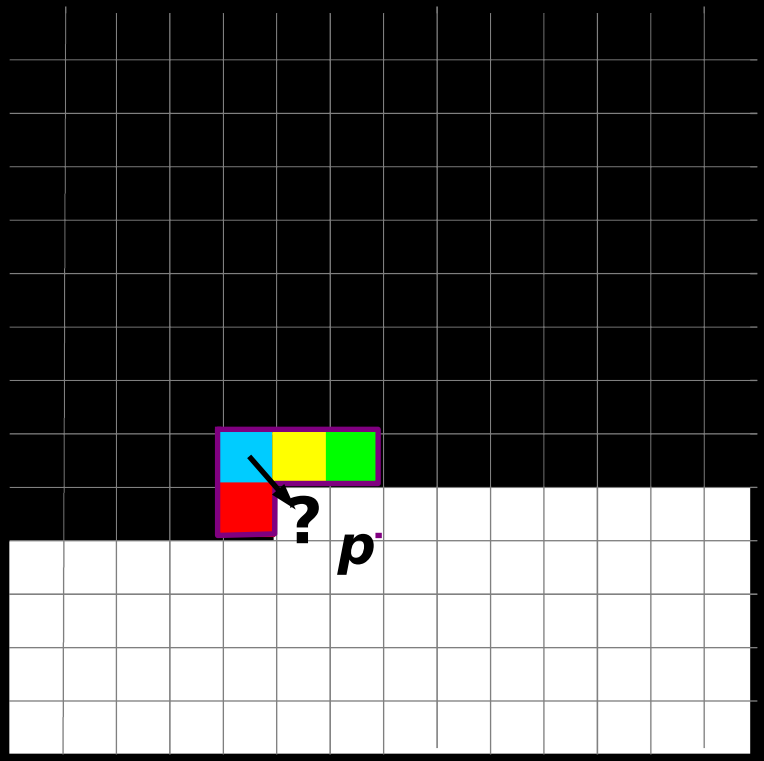
Surface Texton Map & Rendering



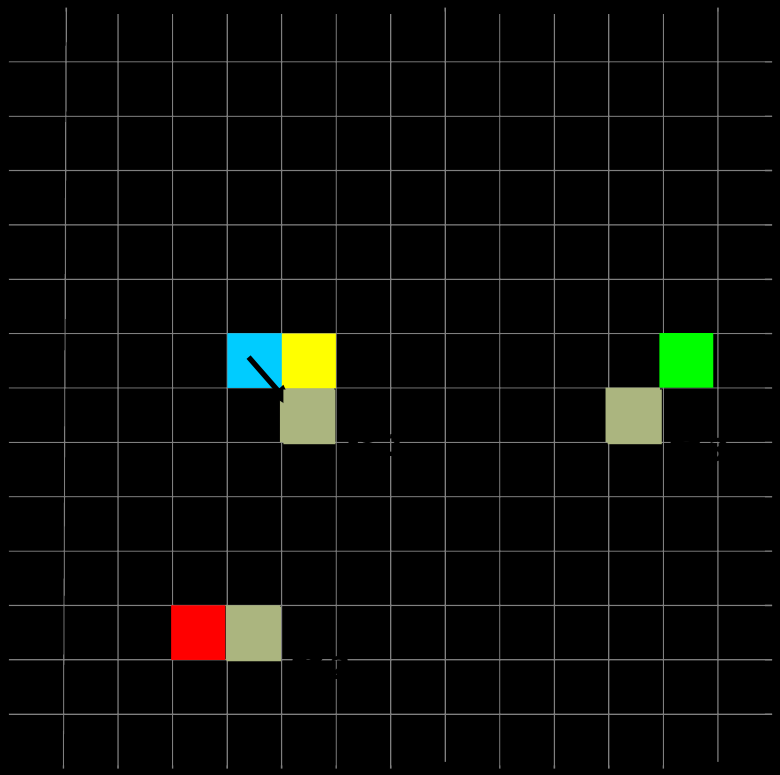
Accelerated Search

- Problem
  - Full search is very slow
  - K-D tree and TSVQ do not work well for BTF
- Solution
  - K-Coherence search
  - Only search “good” candidates in sample texton map

Ashikhmin's Observation



Synthesized Texture



Sample Texture

1-Coherence Candidates:

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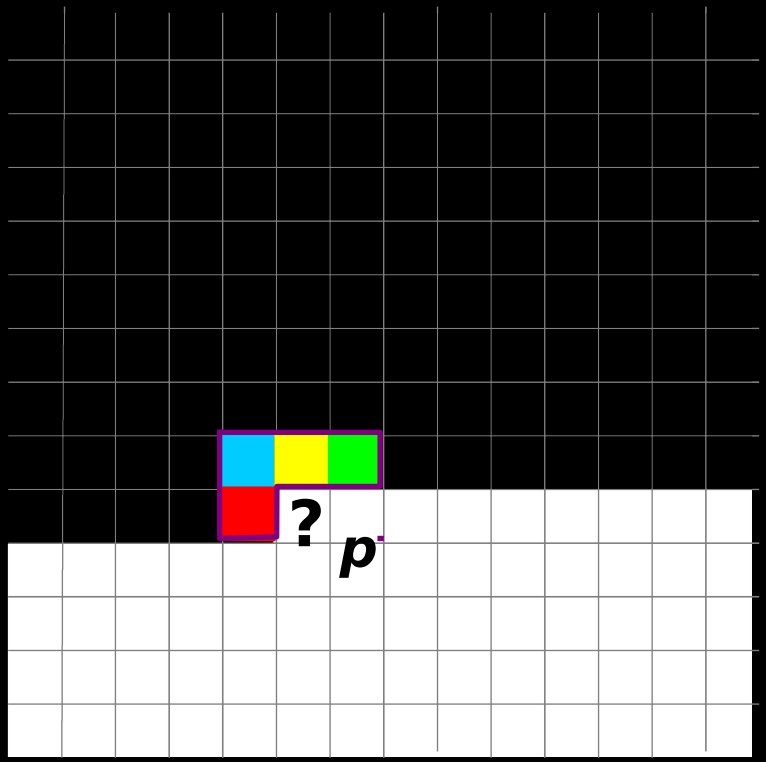
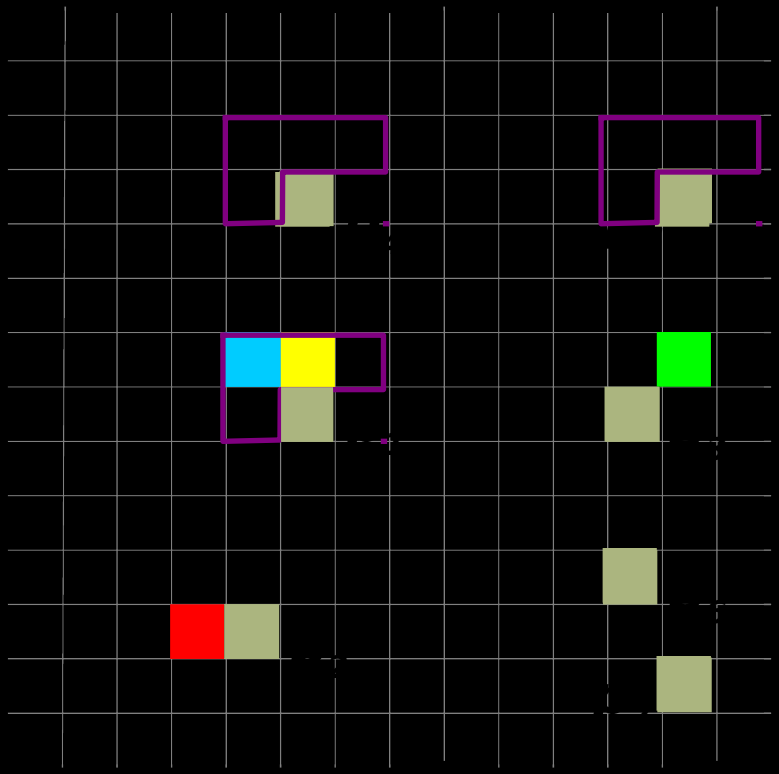
Our Observation



Synthesized Texture



Sample Texture

K-Coherence Candidates:

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Algorithm

- Before Search
  - Precompute K-Coherence (K>1) candidates for each pixel in sample texton map
  - K < 12 is enough for our samples
- During Search
  - Only search the K-Coherence candidates in sample texton map

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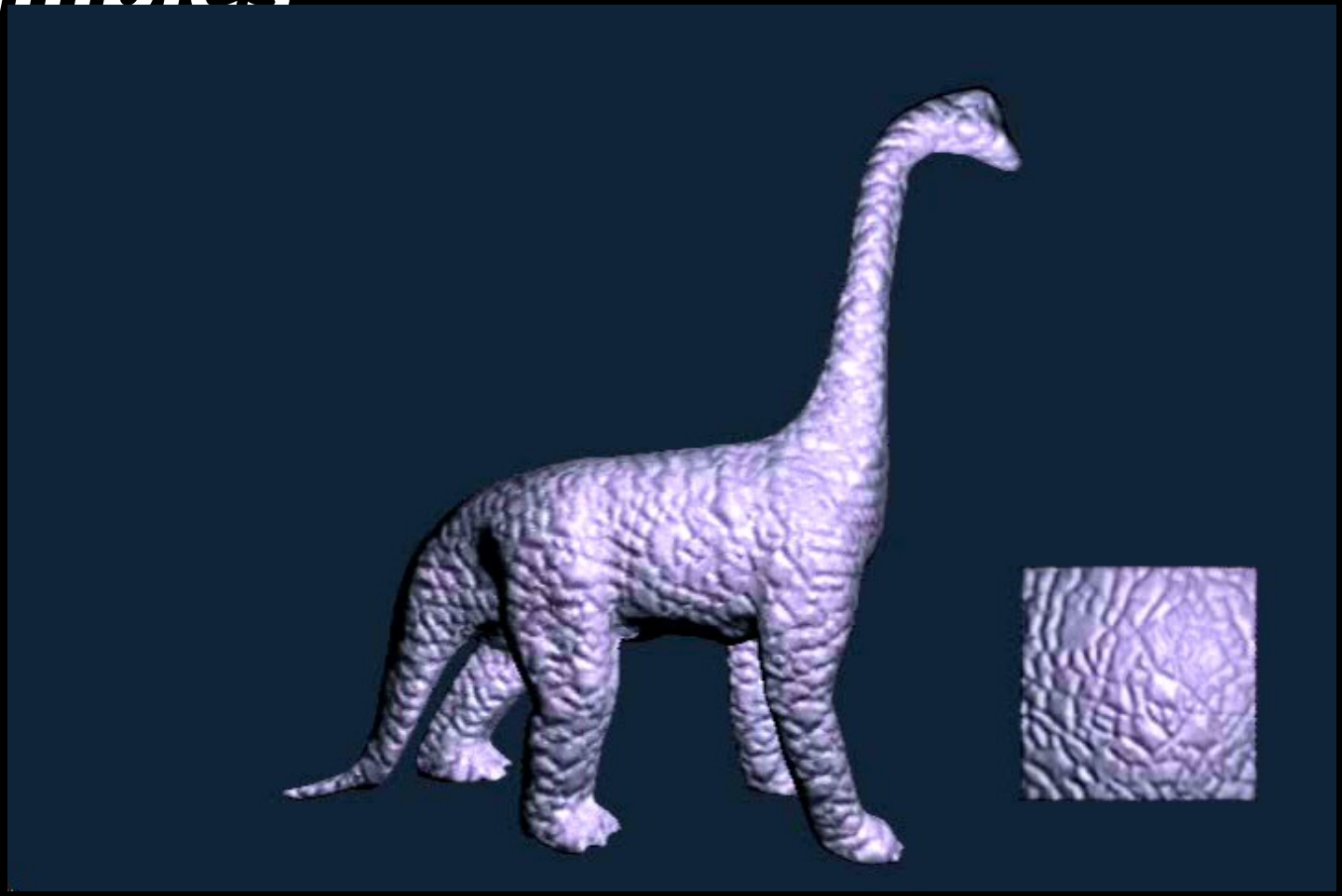
Synthesis Performance

Sample Size	Full Search	K-Coherence
64 × 64	747 minutes	70 minutes
96× 96	3,000 minutes	123 minutes
128× 128	8,066 minutes	157 minutes

- ***Pentium III 700MHZ CPU***
- ***Mesh with 250k vertices***
- ***k = 11 for k-Coherence search***

Synthesis from Real World Samples



3600 BTF samples of 64×64, 250K vertices

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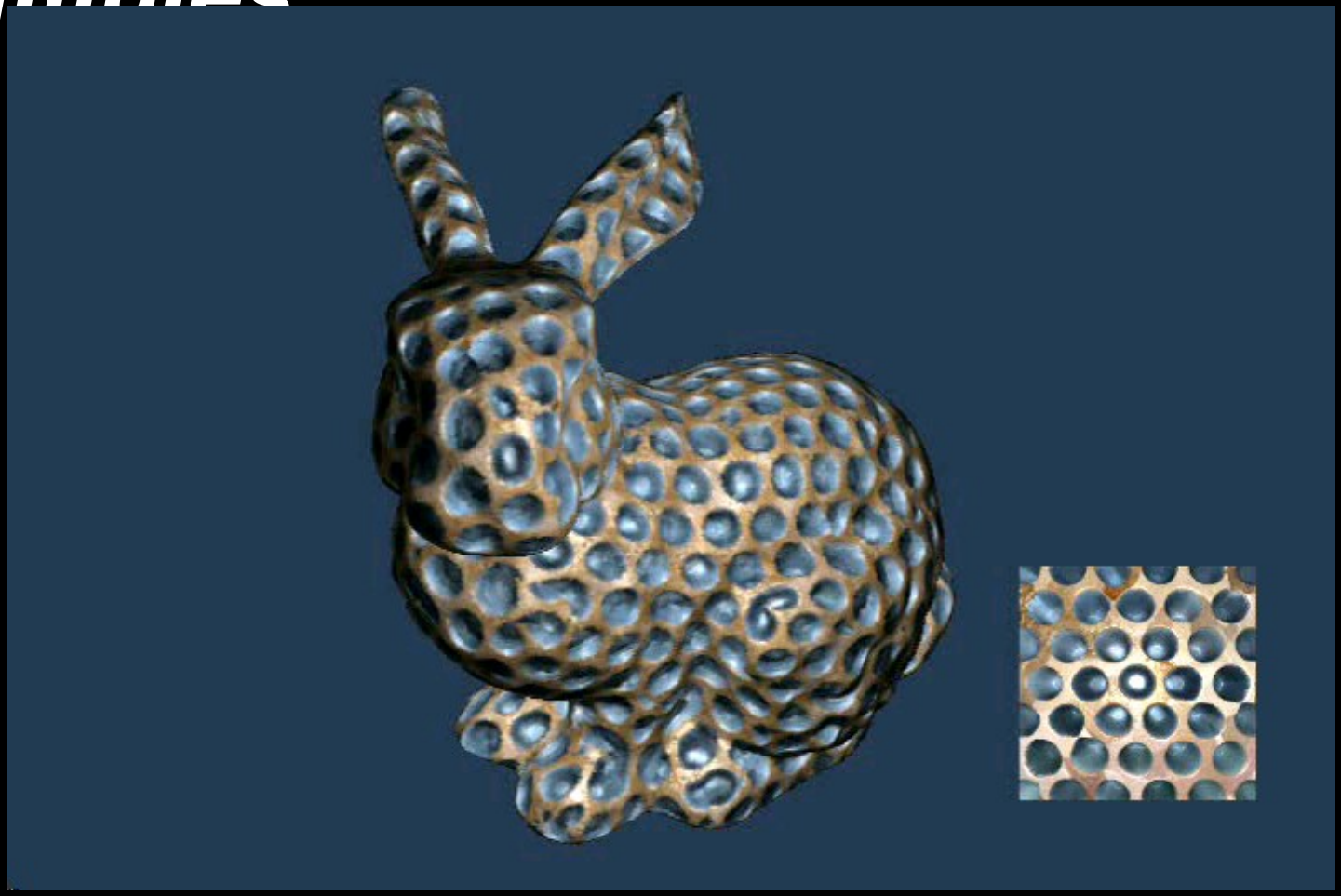
Synthesis from Synthetic Samples



3600 BTF samples of 128×128, 300K vertices

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Summary

- Surface Texton for BTF Synthesis
- Automatic BTF Synthesis on Surface
- K-Coherence Search for Fast BTF Synthesis

Acknowledgement

- Xinguo Liu, Yanyun Chen, Gang Chen and Yin Li (BTF Sample Data)

- Steve Lin (Video Production)

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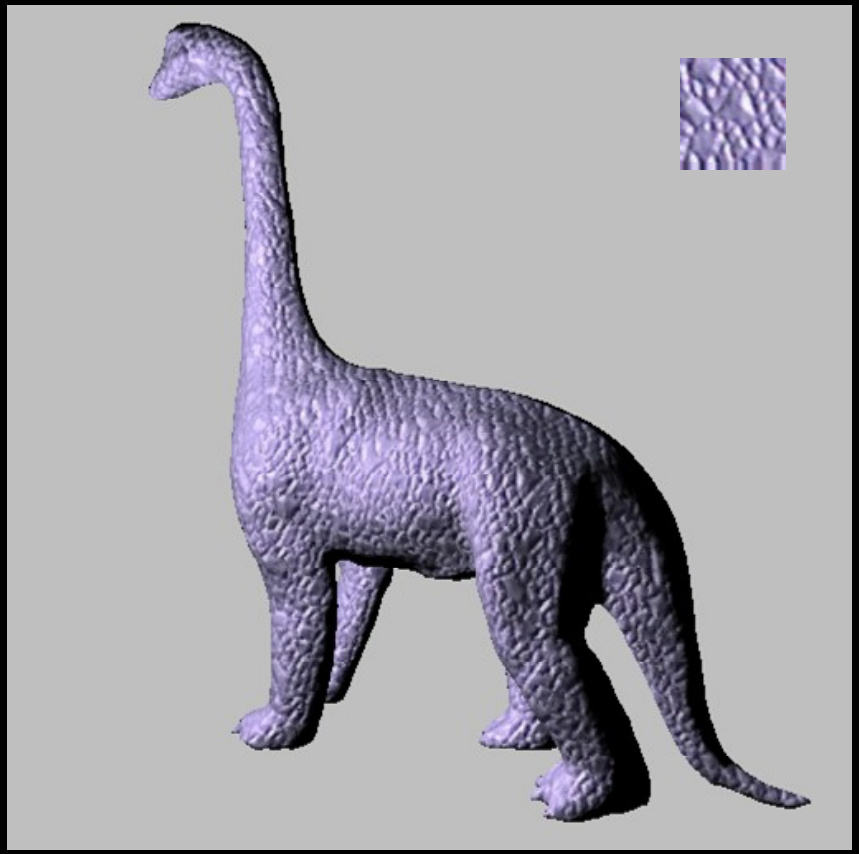
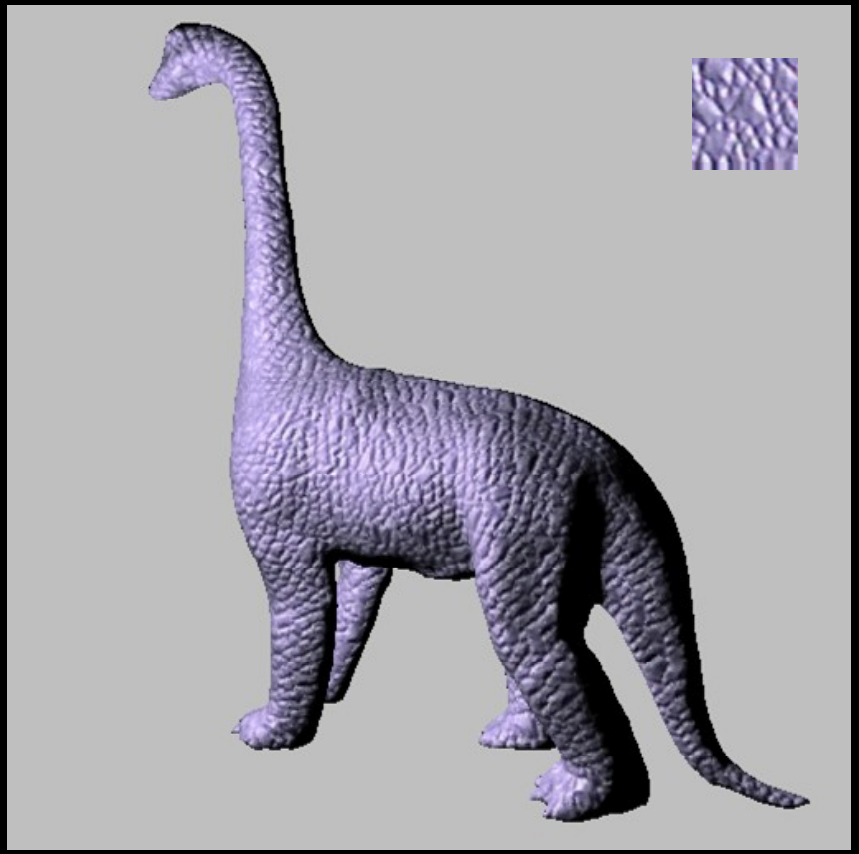
Thank You!

Thank You!

Synthesis Quality



Full Search



K-Coherence (K=11)

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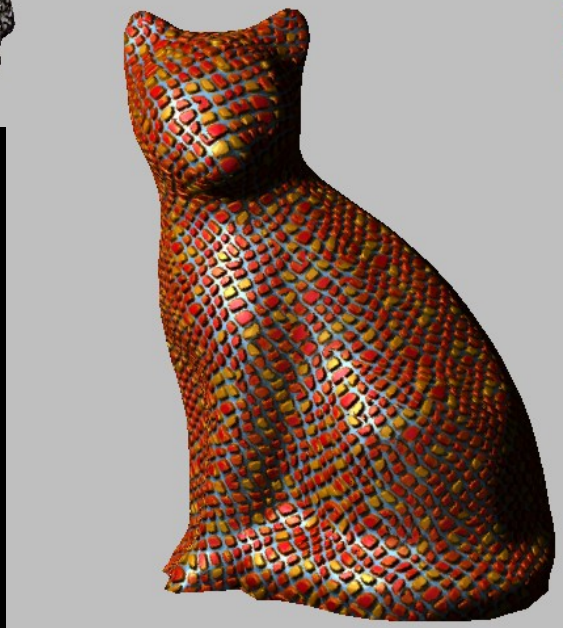
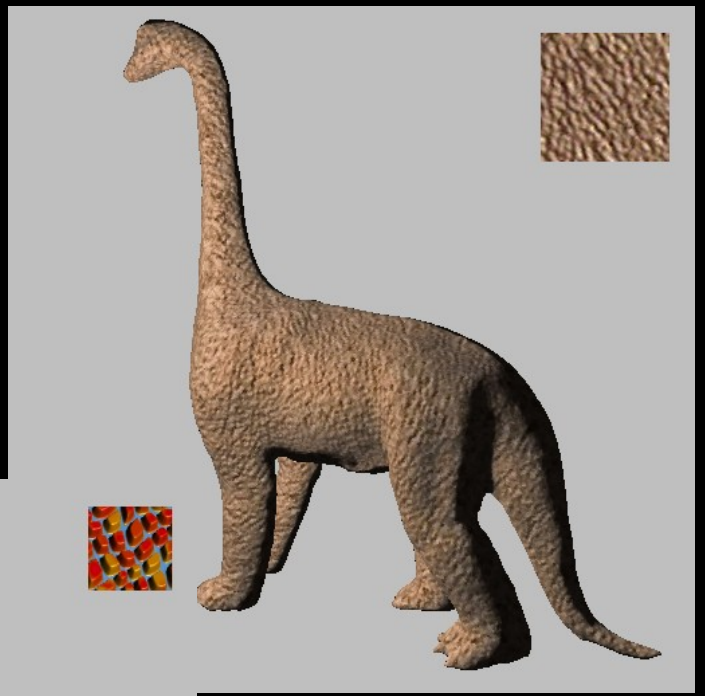
Experimental Results





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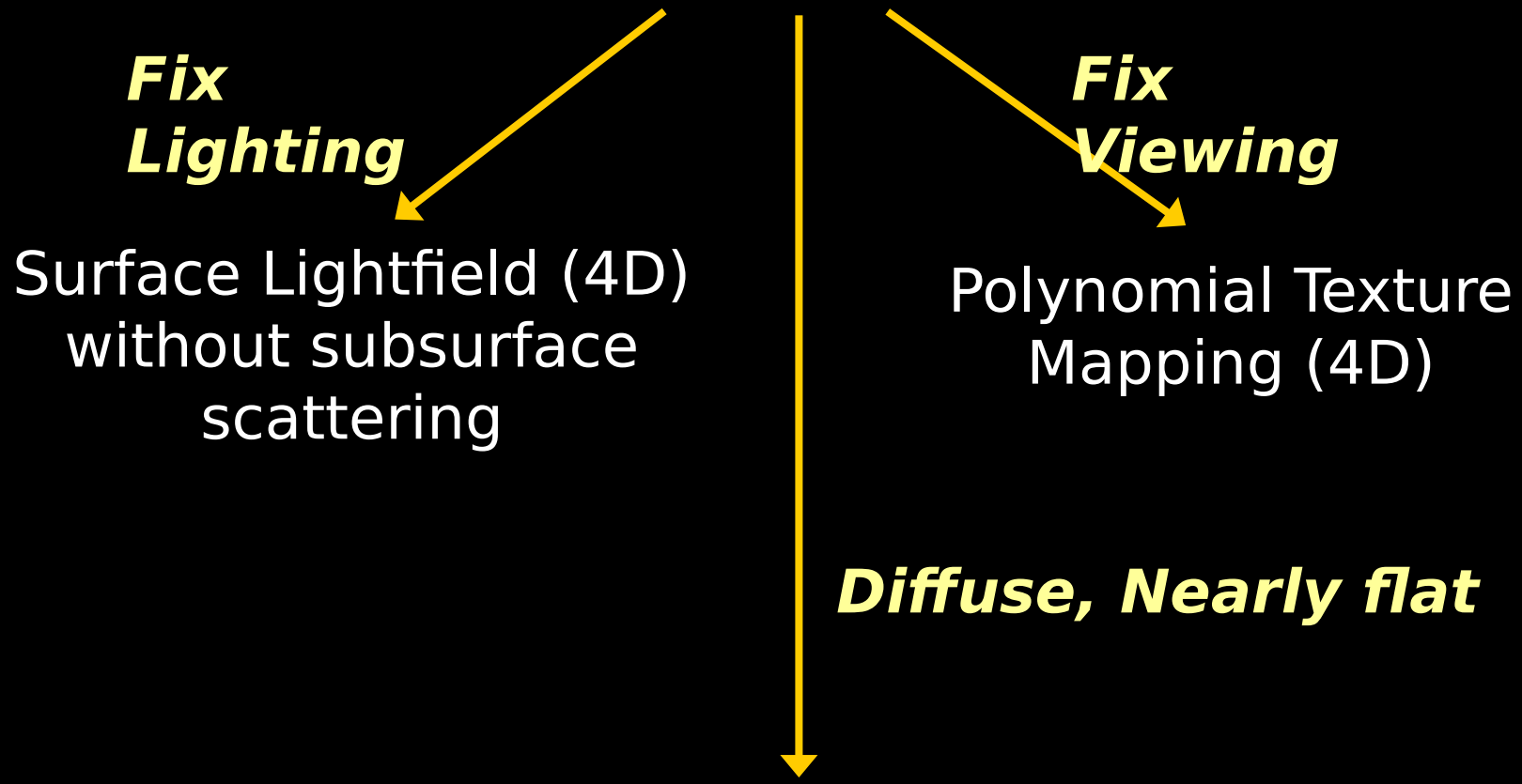
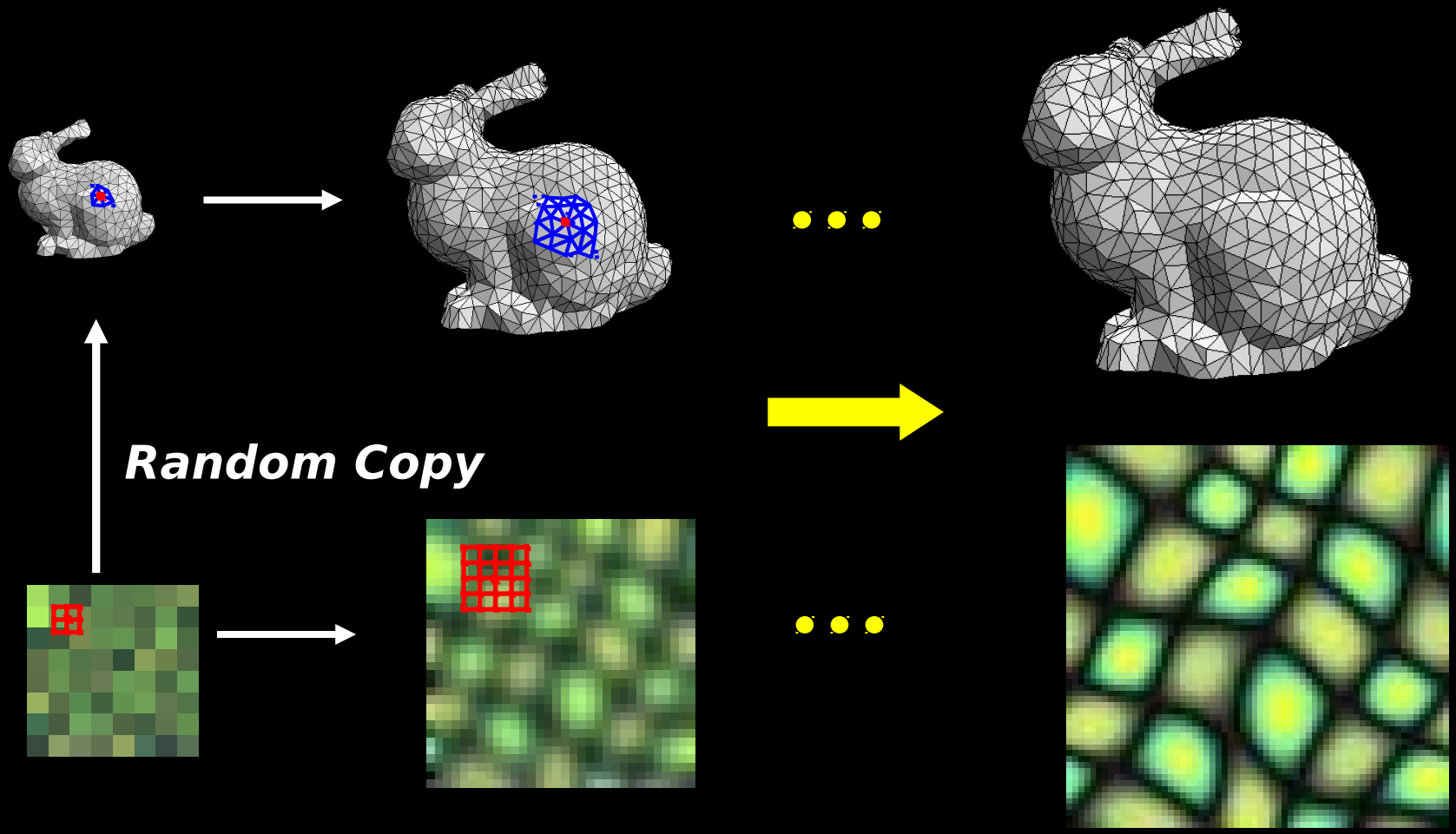

BTF (6D)
Fix Lighting
Fix Viewing
Surface Lightfield (4D) without subsurface scattering
Polynomial Texture Mapping (4D)
Diffuse, Nearly flat
Bump Mapping (2D)

Related Work

- BTF Synthesis
  - BTF morphing [Dana & Nayar 99]
  - **BTF synthesis for real world surface [Liu et. al. 01]**
- BTF Representation
  - Histogram model [Dana & Nayar 99]
  - Correlation model [Suen & Healey 00]

2D Texture Synthesis on Surface



[Wei &Levoy 01] Result is Color for Each Vertex

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